

MANPRINT in the Army Transformation

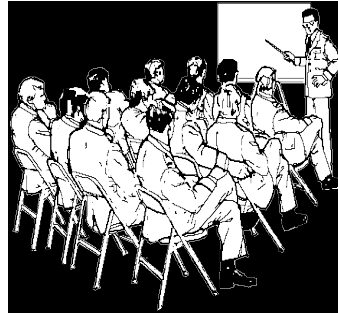
MANPRINT Board of Director's Meeting 23 August 2000

Robin L. Keesee, Ph.D
Army Research Laboratory,
Human Research and Engineering Directorate
AMSRL-HR
APG, MD 21005-5425
(410) 278-5800
rkeese@arl.army.mil



The Soldier is ~~at~~ the Critical System Component!

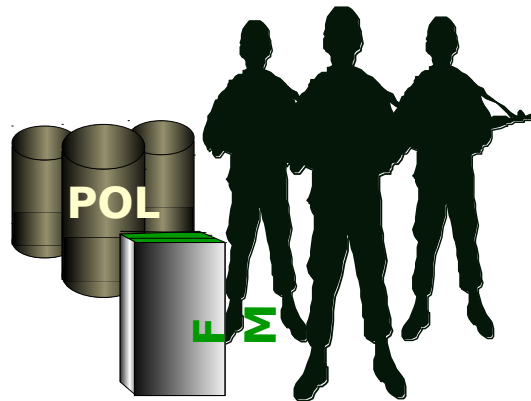
**Soldier-System Task Performance impacts
Force Effectiveness**



**The Soldier
is part of a
force**



THREAT



**Can this soldier,
as part of this
unit, with this
training, perform
these tasks, using
this equipment?**



The MANPRINT Process

MANPRINT Research

MANPRINT Application



- Foundation for MANPRINT
- Tool Development

- IPTs
- MANPRINT Assessment**

- P3Is
- Modifications
- MANPRINT Assessment**

- ICTs
- Development of MNS
- Development of ORD

- IPTs
- MANPRINT Assessment**
- DT & OT data collection

ATDs

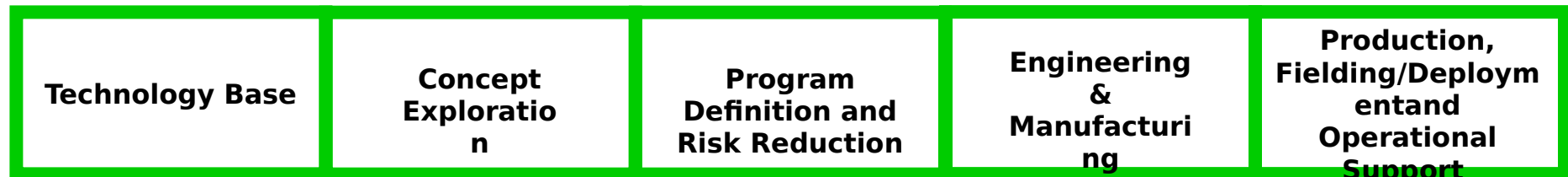
ACTDs

Horizontal & Vertical
Technology Insertion

Non-System Specific

Emerging Programs

Existing Programs Fielded Programs



Technology Base

Concept
Exploratio
n

Program
Definition and
Risk Reduction

Engineering
&
Manufacturi
ng

Production,
Fielding/Deploym
ent and
Operational
Support

MS 0

MS I

MS II

MS III

Conduct Concept Studies

Begin New Acquisition

Enter EMD

Production

511 Acq Programs
293 HRED Supported
142 PM Funded



Unique MANPRINT Issues in the Transformation

***New equipment + new organization =
new soldier-system design
& new manning & personnel issues***

**Multiple simultaneous analyses
required to address System-of-
Systems issues**

Human factors modeling

soldier-system fit & function

soldier task performance

manning & personnel roll-up

extreme conditions

link to soldier life-cycle cost



Jack



IMPRINT (Improved
Performance Research
Integration Tool)



AMCOS (Army
Manpower Cost System)



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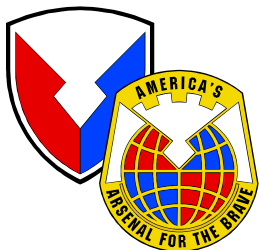
Development
t

MS III

• **Air Warrior**

• **"Fox" NBC Recon Vehicle**

- **I-BCT Modeling Demo**
- **Lessons Learned**



Air Warrior

Focus on aviator needs

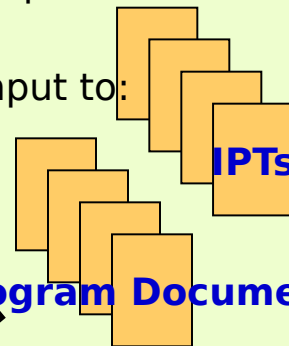
Air Warrior program by its nature is intensively involved with MANPRINT consideration



Mission	Unit and Location	Aircraft	Pilots	Crew
Baseline	Md National Guard Edgewood, MD	UH-1 and OH-58	1	
Extreme Cold	4th 123rd Ft Wainwright, AK	CH-47	3	4
		UH-60	2	8
		UH-1		1 (medic)
Temperate	101st Ft Campbell, KY	CH-47	2	2
		UH-60	3	
		AH-64	12	
	227th Ft. Hood, TX	UH-60	7	
		AH-64	4	
		OH-58D	4	
SOAR	160th Ft. Campbell, KY	MH-47	2	2
		MH-60	2	2
		AH-6	3	
Over Water	U. S. Coast Guard Cape May, NJ	HH-65A	2	1 engineer 1 rescue swimmer
Totals			47	21

Project Support
* Joint government and contractor
MANPRINT Representation on:

Input to:



Program Documents

Tech Base Support

Past Studies:

- ARI
- USAARL
- AFDD

Ongoing:

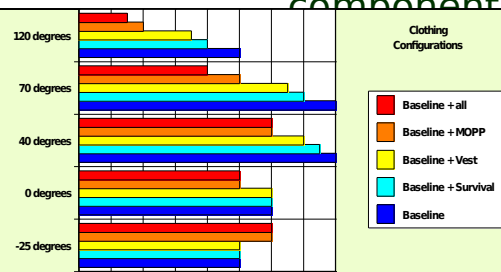
- ARL-HRED

Defined limitations on performance with current ensembles

Developing models to support decisions on selection of new promising components

Complete Program Support

Video Tracking Technology and Human Figure Modeling



Performance Modeling



NBC Reconnaissance Story

Goals of “FOX” Recon System:

- ✓ Reduce crew from 4 to 3 soldiers
- ✓ Use Army maintainers & supplies
- ✓ Add stand-off chemical detection capability (5 km range)

The Problem:

- ✓ 3-person crew rated “unsuitable” & “ineffective” by operational evaluators
- ✓ Dollars to re-design + dollars to re-test exceeded dollars remaining

The Solution:

- ✓ Base system design on:
 - + Human figure modeling
 - + Task-based mission modeling
- ✓ Test to verify model





MANPRINT Modeling Critical to M93A1 Success!



Unsuitable!

Ineffective!

IOT&E

"Fix"

ARL Recommendation:

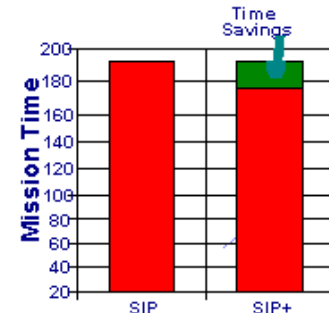
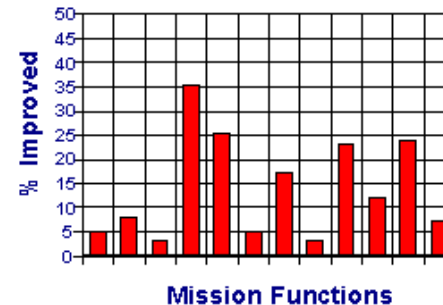
✓ Base M93A1 NBCRS design on;

- + Human Figure Modeling
- + Mission-Based Performance Modeling

✓ Conduct test to verify model

- MANPRINT Modeling Effort Cost =
- Schedule Impact = 4 months

- Layout Re-design
Optimized Crew
Performance
- Model Predicted
"Effective" Mission
Performance



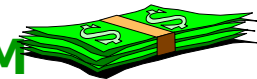
'FOX' • OPTEC Test Verified on Investment = \$2-4 M

Mission Model Prediction Direct ROI (reduced crew, training, etc.) = \$1.5 M/ve

Total ROI resulting from ARL Support = \$137.5 M

OPTEC Accredited Model Support for Block II!

Mission Model
Approved
Jan 98
CG OPTEC





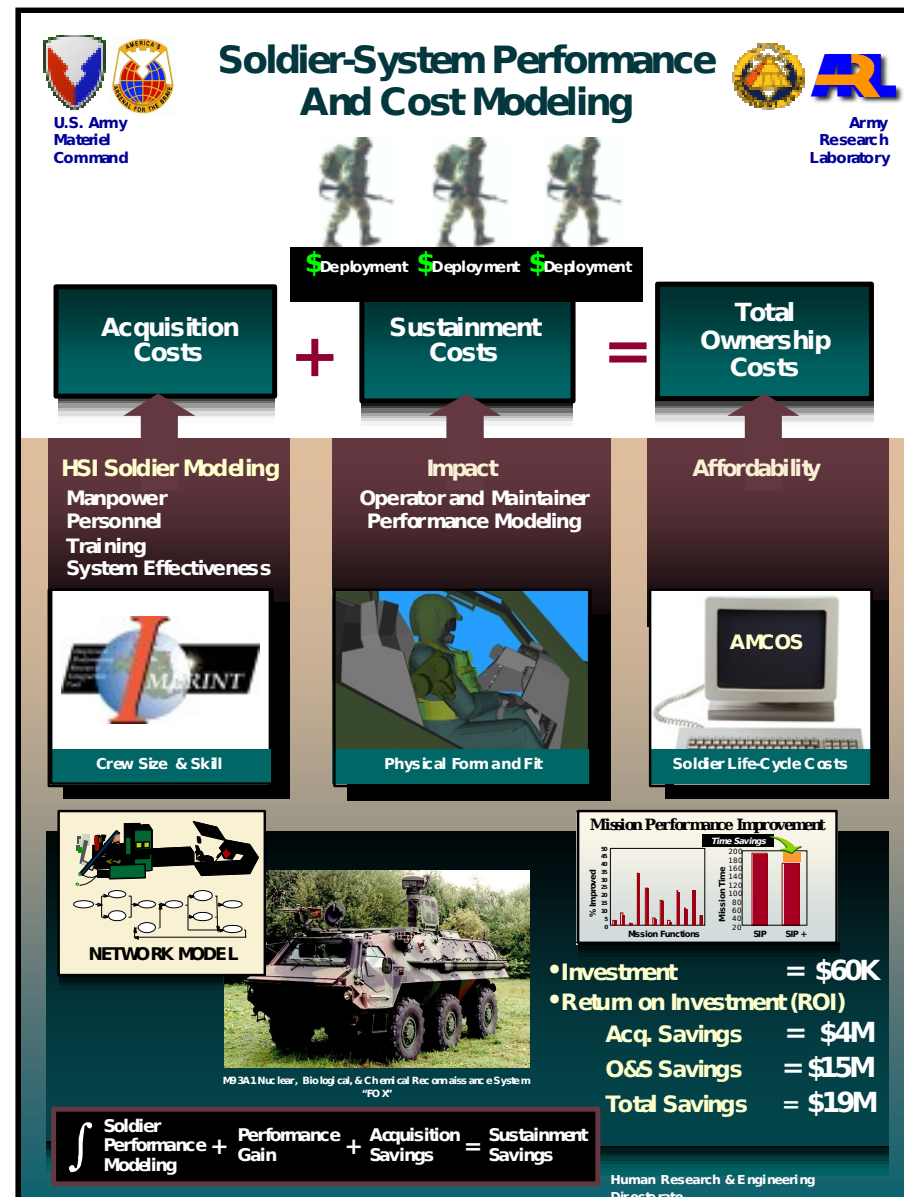
I-BCT Modeling Demo

First cut mapping Ord & O&O to HF issues

By ARL-HRED using HF and system expertise
IAV acquisition issues vs.
new Bde

Identify needed data vs. available data

Data are “moving target” with rapid acquisition, e.g., TOE, RSTA operations, standard scenario, detailed maintenance data
While data are being obtained, historical and SME data stand-in





I-BCT Modeling Demo

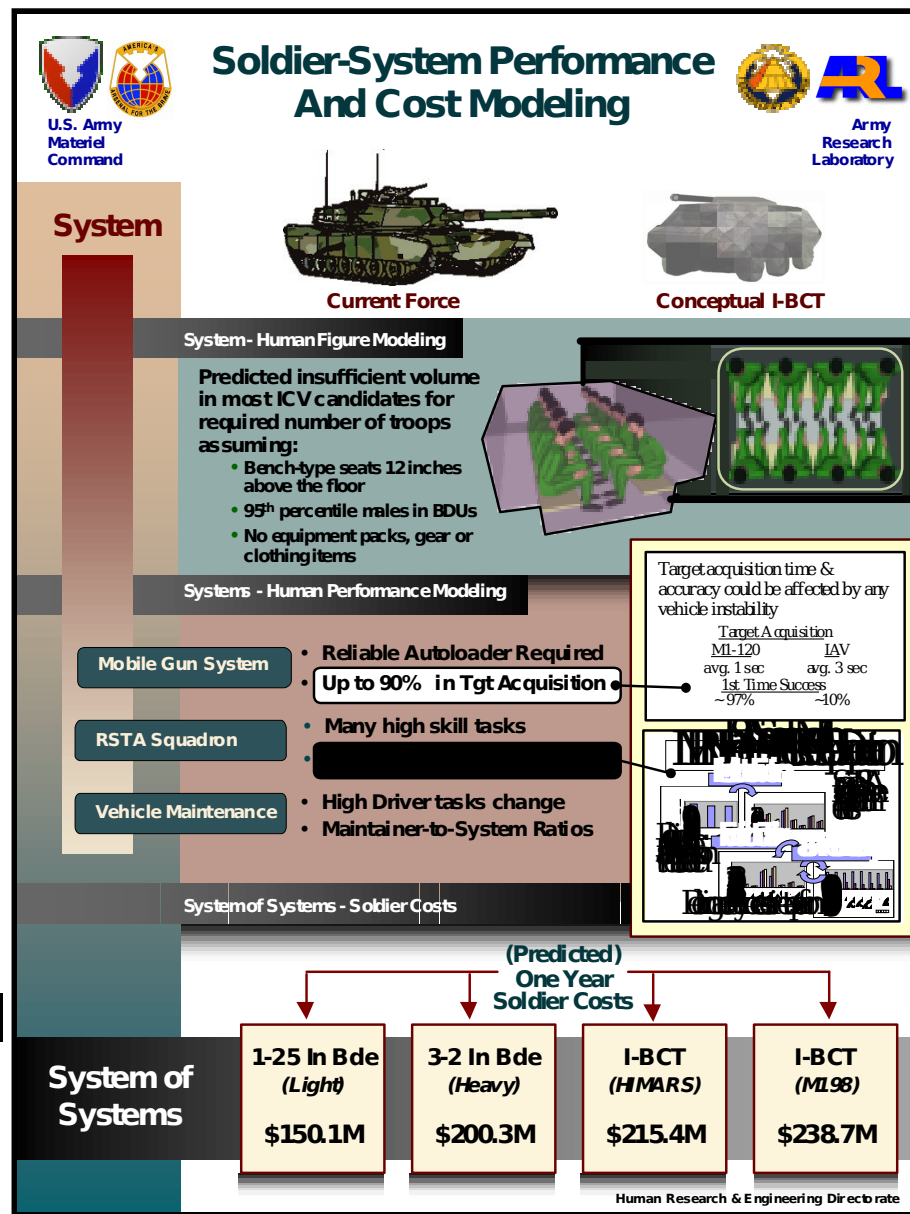
A means of gathering insight into

system design & soldier performance

manning and personnel issues across systems of systems

soldier-system performance under extreme conditions

A means to link soldier performance, manning, & personnel to lifecycle cost





Lessons Learned

User and Developer Commitment to the Soldier as the Critical System Component:

- Reduces Risk
- Saves Acquisition Time and Funds

Require the contractor to use:

- Integrated Product Teams with MANPRINT or HSI Representation
- Up-front input from the MANPRINT domains
- Continuous evaluation; Interactive feedback loops
- Modeling Tools
 - **Transom Jack--** anthropometric human figure model
 - **IMPRINT--** a soldier workload and MPT

Light and Medium Armored & Wheeled Vehicles

Human Research and Engineering Directorate U. S. Army Research Laboratory

Lessons Learned

ARMORED GUN SYSTEM

ARMORED SECURITY VEHICLE

FOX

AAV

HMMWV

*Robin L. Keese, Ph.D.
Director, Human Research & Engineering
Army Research Laboratory*

*Prepared by:
Bruce E. Amrein
Kathy Leiter*



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Development

• Crew Integration and Automation

• Effect of Vehicle Movement on Squad Performance

• Indirect Vision Driving

• Soldier Focused Research for FCS



Soldier Focused Research for FCS



**Provide the advanced tools
needed for the Army
information by maximizing the
soldier's contribution to
mission success.**

- Model the soldier's contribution to complex systems-of-systems and unit performance.
- Evaluate soldier performance under all conditions (heat, fatigue, workload, stress, etc.) and all missions.
- Reduce time needed to model systems from months to days.
- Ensure soldiers can achieve full FCS potential
- Evaluate tool usability, utility and



"Without highly skilled, competent, and dedicated people, it does not matter how lethal our weapons are or how strategically responsive our formations are because the Army is people..." The Army Vision, Feb 2000



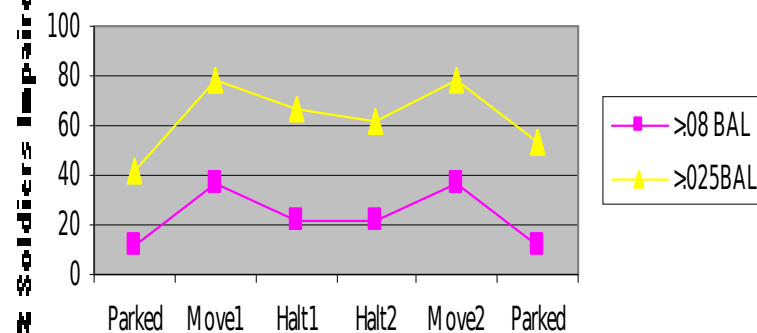
Effect of Vehicle Movement on Squad Performance

Vehicle Movement

- Induces a broad range of cognitive performance decrements.
- Symptoms persist more than 24 hours in 9.5% of victims
- Physical impairments include discoordination, dizziness, headache, sore neck and extremities, indigestion, and



backache.



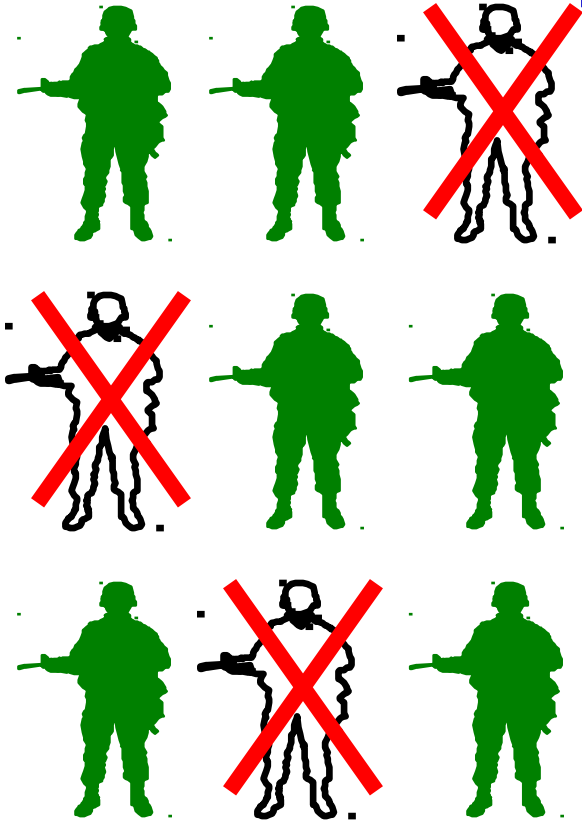
Performance scores are shown as the degradation equivalent to 0.08 and 0.025 Blood Alcohol Level (BAL)

Command and Control Vehicle

- Produced Moderate to Severe Symptoms (Drowsiness, Headache, Nausea, Vomiting) in 55% of soldiers.
- Performance decrement was equal to alcohol impairment in 37% of subjects during movement and 20% of soldiers during short halts



Effect of Vehicle Movement on Squad Performance



The first minutes out of the vehicle are the most critical.

- Situational Awareness
- Mobility
- Target Identification and Acquisition

Over one-third of the force may be ineffective on leaving the IFV





Indirect Vision Driving



**HMMWV outfitted
with 3 Flat Panel
Displays**



**Ground Vehicle
Experimentation
Course**

- Study conducted in Spring 1999 at APG examined display field of view (FOV) - 110 degrees - compared to 3 camera FOVs: 150, 205, 257
- Crew performance was optimized when camera field of view was closest to the display visual angle
- Indirect Vision Driving increased symptoms of motion sickness and increased mental workload
 - Disabling Motion Sickness was experienced by 2 out of 10 participants due to altered visual cues
 - Some degree of Motion Sickness was experienced by 7 out of 10 participants
- Wider FOVs reduced speed and increased errors

Results briefed to TARDEC in Aug 1999

Report finalized in March 2000

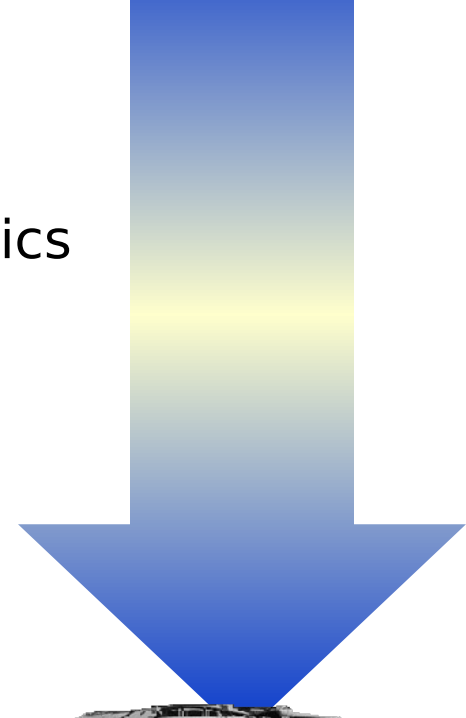
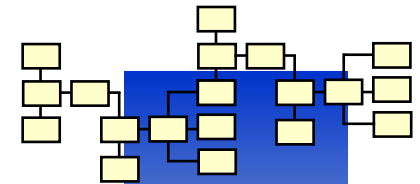
Display recommendations transitioned to the CAT ATD



Crew integration Automation Testbed Advanced Tech Demo (CAT ATD)

ARL HRED CAT ATD Deliverables FY00-04

- ➔ FY00 – Develop task and workload models to target areas of opportunity for CAT ATD crew size reduction.
- FY01 – Integrate modeling results with Vetronics Technology Testbed FY00 findings to form baseline CAT ATD crew station designs.
- FY02 – Select and tailor route planning, cognitive decision aids, DEMO III driving automation, and multi-modal information presentation technologies (e.g. speech recognition, 3D audio, etc.) for CAT ATD crew stations.
- FY03 – Support TARDEC in planning and conduct of CAT ATD technology tests and





Summary

- ➔ **Early MANPRINT application can significantly impact system and unit performance and cost.**
- **Modeling tools and data are available NOW to address many soldier-system issues.**
 - ➔ Transom Jack (Human Figure) commercially available. (9 applications to systems just from HRED)
 - IMPRINT (Task Workload) widely available. (Library of 25 applications, including selected IBCT functions)
- **Systems-of-systems analysis tools could be accelerated to address more complex FCS human dimension issues.**

